Summary Report on the Deep Space Network/Viking Flight Project Telecommunications Compatibility

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The Viking Flight Project/Deep Space Network (DSN) Telecommunications Compatibility Test Program consists of three phases: subsystem design, system design, and system verification tests to be performed at the Jet Propulsion Laboratory and at the Air Force Eastern Test Range/Kennedy Space Center complexes. Subsystem design tests were performed with the Viking Orbiter (VO) and the Viking Lander (VL) during 1973. System design compatibility tests were performed with the Viking Orbiter, Viking Lander, and a multiple Viking spacecraft configuration during the summer of 1974. This article describes the system design tests and test results that provided the basis for the establishment of telecommunications system design compatibility between the DSN and the Viking Lander, Viking Orbiter, and a simulated DSN/multiple spacecraft configuration for the Mars planetary orbital operations.

I. Introduction

In order to avoid the difficulty previously experienced by the DSN and Flight Project in establishing and verifying the system interfaces, an overall compatibility test plan, the Viking 1975 Master Integrated Test Plan (MITP) PL-3710005, was developed and agreed to by all major Viking Project systems. The test plan specifies that telecommunications design compatibility would be established at the subsystem and system levels and conclude with a final verification test at Cape Canaveral, Florida, prior to launch. The test plan also specifies the ground and Flight Project equipment/software configuration pretest requirements and the test objectives in all phases.

Results of Phase I testing (subsystem level) have been documented in JPL internal memorandums and are not discussed in this article.

Phase II, system level testing, of the DSN/Viking Project Telecommunications Compatibility Test Program was performed in the summer of 1974, and the results are reported in detail in this summary report. The general objective of this series of tests was to establish the telecommunications system design compatibility between the Orbiter, Lander, a multiple (Orbiter/Lander) spacecraft configuration, and the DSN.

Phase III (system verification) of the test program is to be performed at Cape Canaveral, Florida, between the DSN and each flight Orbiter, Lander, and spacecraft (combined Orbiter and Lander) configuration. The objectives of these tests are to verify continued DSN/Flight Project interface compatibility with flight spacecraft.

Procedures for conducting the compatibility tests for the DSN ground station, as well as test design criteria and test parameters for the ground station hardware and software were prepared by the DSN. Spacecraft telecommunications design performance criteria and test parameters to establish Project nominal and threshold telecommunication conditions were provided by the respective Orbiter/Lander telecommunications teams. The test criteria were included as part of the test procedure to provide real-time assessment of performance. All test procedures, which include test parameters and performance criteria, were approved jointly by the DSN and Flight Project representatives.

II. Phase II Test Report

The Phase II test report includes the DSN/Flight Project compatibility testing between a simulated operational Deep Space Station (CTA 21) and the Viking proof test Orbiter, the Viking spacecraft test Lander, and a simulated multiple spacecraft configuration. For the multiple spacecraft configuration, the proof test Orbiter and spacecraft test Lander were located in the Spacecraft Assembly Facility (SAF). An RF test transmitter, located in the screen room of CTA 21, was used to simulate the second Orbiter S-band downlink.

Each of the three tests is discussed with regard to test objectives, conditions, and results. In addition, Tables 1, 2, and 3 present detailed information on the DSN and Viking spacecraft configurations, test parameters, test criteria, and test results. Table 4 defines the terms used in these tables.

A. DSN/Viking Spacecraft Test Lander Compatibility Testing

1. Test objectives. The objectives of this test were:

(1) To prove telecommunications design compatibility between the DSN and the Viking spacecraft test Lander in accordance with the Master Integrated Test Plan (PL-3710005).

(2) To prove DSN/single spacecraft performance prior to the conducting of the multiple spacecraft RF compatibility tests.

(3) To provide prerequisite data bases for performing the data compatibility tests (DCT 1 through 5) which establish data flow system interface compatibility from the spacecraft via the DSN to the Viking Mission Control and Computing Center (VMCCC).

2. Test conditions. The spacecraft test Lander (S/C TL) was configured to represent a flight spacecraft telecommunications subsystem, and CTA 21 was configured to represent a DSN 64-m antenna station. The S/C TL was located in the screen room of Building 179 (Spacecraft Assembly Facility) at JPL, and CTA 21 is located in Building 125. An S-band RF air link was established between the S/C TL and the ground station. The DSN established a pretest calibration of this air link to an amplitude stability of ±0.2 dB. The ground station software utilized in these tests was the released version of telemetry and command data (TCD) DOI-5050-OP-C, which will be used to support the mission.

3. Test descriptions. Table 1 provides a listing of the tests performed; detailed test descriptions are contained in Ref. 1 for each test listed. In general, nominal and threshold tests are performed in the areas of S-band RF, telemetry, command, and metric data.

4. Test results. The results of the 60 h of tests established telecommunications system design compatibility between the Viking Lander spacecraft and the DSN. Table 1 provides the test data in summary form.

B. DSN/Viking Proof Test Orbiter Compatibility Testing

1. Test objectives. The objectives of this test were:

(1) To establish DSN/Viking Orbiter telecommunications compatibility for telemetry, command, tracking, and metric data in accordance with the Viking Project Master Integrated Test Plan (PL-3710005).

(2) To provide baseline criteria for analysis of the multiple carrier interference effects in the multiple spacecraft RF compatibility tests.

(3) To provide prerequisite data bases for performing data compatibility tests.

2. Test conditions. The Orbiter proof test spacecraft was located in JPL Building 150 (Space Simulator), and S/X-band RF links were established to CTA 21 in Building 125. Both the S-band and X-band links were calibrated by the DSN, and RF amplitude stability was established for a 3-sigma measurement of 0.2 dB for S-band and 1.0 dB for X-band.

With the exception of the Block IV receiver/exciter (an engineering prototype), CTA 21 was configured to simulate a DSN 64-m antenna station utilizing operational hardware and TCD software (DOI-5050-OP-C).

Coordination between the spacecraft and CTA 21 was excellent, and testing was well coordinated considering the Project spacecraft priorities in the Space Simulator, which placed compatibility testing as a second priority.

3. Test descriptions. Table 2 provides a listing of the tests performed; detailed test descriptions are contained in Ref. 1 for each test listed. In general, nominal and threshold tests were performed in the areas of S-band RF, telemetry, command, and metric data.

4. Test results. The results of the 90 h of tests established telecommunications system design compatibility between the Viking Orbiter spacecraft and the DSN. Table 2 summarizes the test results.

C. DSN/Viking Multiple Spacecraft Compatibility testing

1. Test objectives. The objectives of the compatibility tests were as follows:

(1) To verify the performance and operational capability of the DSN in a multiple downlink carrier environment

(2) To ascertain the performance of the Orbiter and Lander under predicted RF interference conditions

(3) To provide baseline criteria as a prerequisite to conducting the multiple spacecraft data compatibility tests (DCT-5)

All tests were accomplished in accordance with Refs. 1 and 2, as revised by VICs 621 and 658.

2. Test conditions. The spacecraft, Orbiter, and Lander, were located in the Spacecraft Assembly Facility. A test transmitter, to simulate the second Orbiter with an S-band RF downlink capability only, was installed in the screen room of CTA 21. S/X-band RF air links were established between the Orbiter spacecraft and CTA 21. Interface with the Lander was established with an S-band RF air link between CTA 21 and SAF. To support these tests, CTA 21 provided two simultaneous S-band uplinks and received and processed telemetry data from three simultaneous downlinks.

3. Test descriptions. In addition to the standard compatibility tests with all RF frequencies at their nominal rest values, the following tests were performed to simulate the potential frequencies of the flight spacecraft under expected doppler effects and S-band power levels during Mars orbital operations. These special RF interference tests are described in detail below, as they are not discussed in Ref. 1. The proof test Orbiter was on RF Channel 9, the spacecraft test Lander was on RF Channel 13, and the test transmitter was assigned to RF Channel 20.

a. False uplink acquisition with ranging. With S-band RF Channels 13 and 20 uplinks adjusted to expected Orbiter RF received levels at Mars distances, ranging modulation was applied to Channel 13 uplink, and the uplink was swept through the assigned Lander channel. The Orbiter was observed for acquisition of a ranging sideband, with subsequent loss of downlink RF lock.

b. False command acquisition with ranging. A single Channel 20 uplink was tuned to a specified offset from the assigned channel frequency. Command and ranging modulation were then applied, and the carrier was swept through Channel 20. The Orbiter was observed for RF and command acquisition, and the Lander was observed for RF acquisition.

c. Radio metric degradation with ranging. With the Orbiter and Lander both in the two-way mode, the Lander uplink was set to an expected Orbiter RF received level, and ranging acquisitions of the Orbiter were conducted to obtain reference performance data. The Lander uplink (Channel 13) was then tuned to a specified offset from the assigned channel frequency. Ranging modulation was applied to the Channel 13 uplink, and the uplink was swept through the frequency band. During the sweep of Channel 13 uplink, continuous ranging acquisitions of the Orbiter were obtained, and data were analyzed for variations in range delay.

d. Viking Lander telemetry degradation by the Viking Orbiter high-rate telemetry. With the Orbiter and Lander both in the two-way mode, a baseline telemetry performance test was conducted. The Orbiter uplink was then tuned to specified frequency offsets, and all telemetry channels, at each frequency offset, were observed for performance degradation.

e. Command and telemetry degradation with ranging. With the Orbiter and Lander both in the two-way mode, the Lander uplink was set to an expected RF Orbiter received level, and continuous commands were sent to the Orbiter to obtain reference performance data. The Lander uplink (Channel 13) was then tuned to a specified offset from the assigned channel frequency. Ranging modulation was applied to the Channel 13 uplink, and the uplink was swept through the frequency band. The Orbiter was observed for loss-of-uplink lock, command anomalies, and telemetry degradation.

4. Test results. The results of the 40 h of tests established telecommunications system design compatibility between the Viking multiple spacecraft and the DSN. Table 3 provides a summary of the test results. The following comments describe test results from the series of special RF interference tests (3a–e above). The RF channels and their center frequencies for these tests are shown in Table 5.

In the special tests, RF frequencies selected to generate RF interference represent considerable offsets from assigned center frequency (ACF) values. However, each of those frequencies is considered possible during the mission. The total offset from ACF was derived from consideration of the VCO rest frequency offset from ACF, VCO drift, temperature effects, and orbital doppler shift. The absolute value of the frequency offset for each test is provided in the discussion below.

Interference from ranging sidebands will occur only during range acquisitions. Immediately following a range acquisition, the code is advanced to the clock component (C_1) only, and all sidebands around higher-order components disappear.

a. False uplink RF acquisition with ranging. The following are the results from the special test described in 3a. The Orbiter uplink (Channel 9) was acquired by the fifth sideband of the second ranging component on the Lander uplink (Channel 13) at a signal level of −137 dBm. The Orbiter was also acquired by the tenth sideband of the third ranging component at a signal level of −150 dBm. These results were as predicted from theoretical analysis. For this test, the Channel 13 uplink was inadvertently set 9 dB below the expected value. The expected interfering levels are, therefore, 9 dB higher than those observed in the test. The frequency offset of Channel 13 was 77.3 kHz below ACF.

Proof Test Orbiter System Problem/Failure Report (P/FR) No. 34395 was generated to document the Orbiter acquisitions observed in this special test.

All tests were successfully completed, and no degradation of downlink thresholds was observed.

b. False command acquisition with ranging. The following are the results from the special test described in 3b. The Orbiter uplink was acquired by the 29th sideband of the third ranging component on a Channel 20 uplink. For this test, the frequency of Channel 20 was set 9.75 kHz below ACF. During the sweep, a command detector in-lock indication was observed.

Proof Test Orbiter System P/FR No., 34395 was generated to document the Orbiter acquisitions observed during this special test.

c. Radio metric degradation with ranging. The following data were obtained from the special test described in 3c: VO reference delay, 5330.1 range units (RU) ± 3.67 (1 sigma); 1 RU = 0.947 ns. VO delay with VL ranging, 5327.3 RU ± 6.64 (1 sigma); 1 RU = 0.947 ns. The data indicated a degradation of the Orbiter ranging function under the established test conditions. The frequency offset on Channel 13 was 77.3 kHz below ACF.

d. Viking Lander telemetry degradation by the Viking Orbiter high-rate telemetry. The following are the results from the special test described in 3d. For this test, two VO (Channel 9) offsets were set. The first offset was established at 27.3 kHz above the Channel 9 ACF, which placed a VO telemetry harmonic on the VL downlink carrier. The second offset was set at 49.4 kHz above the ACF of Channel 9. For this condition, the fifth harmonic of the VO high-rate telemetry channel coincided with the third harmonic of the VL high-rate telemetry channel. In this test, discrepant test data on VL high-rate telemetry were obtained. The low signal-to-noise ratio (SNR) reading remained constant throughout the entire test. This discrepancy was attributed to an intermittent subcarrier demodulator assembly (SDA 2), which had caused anomalies in previous tests. Verification of the cause of the test discrepancy was obtained in the conduct of DCT-5, as the same test parameters were established and the test data obtained were within the established criteria.

A spurious signal (spur) was observed in the VO X-band downlink spectrum during all tests under the conditions of having the Channel 13 uplink transmitter and the VO ranging channel ON. The spur was seen on the spectrum analyzer associated with the Orbiter X-band transmitter support equipment. With the Channel 13 uplink signal

level established at the predicated mission value, the spur was observed to be located ±1.4 MHz (approximately) about the carrier at a level of -20 dB relative to the carrier. No spurs were observed in the S-band downlink spectrum. Since a difference in the Channel 9 and 13 uplink frequencies of 1.36 MHz is within the ranging bandwidth (1.5 MHz) of the VO, the presence of a spur in the X-band downlink is to be expected under these test conditions. The presence of a 1.4-MHz spurious signal under the established test conditions is documented in Proof Test Orbiter System P/FR No. 34392.

e. Command and telemetry degradation with ranging. The following are the results from the special test described in 3e. No degradation in the Orbiter telemetry and command performance was caused by the Lander ranging sidebands. For this test, Lander Channel 13 was offset 77.3 kHz below ACF.

III. Conclusions

The successful completion of the DSN/Viking Flight Project telecommunications system design compatibility tests at JPL represents a significant Project event. It can be assumed with high probability that the system design tests established that the DSN and the Viking spacecraft telecommunications links will satisfy mission objectives and that, when an RF link interference occurs during operations, the interference effects will be reasonably well understood.

The formal compatibility test program developed jointly by the DSN and the Viking Flight Project has been successfully performed on schedule and at anticipated cost. This success has been achieved because of the close coordination and cooperation of the multiple organizations involved.

Phase III of the compatibility test program, to establish the continued telecommunications interface compatibility following transportation of the flight spacecraft to Florida, is scheduled to commence in late January 1975 and will continue until the summer launch in 1975.

References

1. *Deep Space Network/Flight Project Interface Compatibility Test Design Handbook*, 810-8, Rev. A, DSN Standard Practice (JPL internal document).
2. *Viking 1975 Master Integrated Test Plan*, NASA Document PL-3710005.

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/8	D/L threshold one-way	1A	−145.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	5B	
		1B	−149.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	6B	
		1C	−149.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	7B	
7/9	U/L threshold	2A	−100.0 (2)	−139.5 (1)	OFF	OFF	N/A	N/A	N/A	N/A	3	
			−100.0 (2)	−142.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	3	
7/8		2B	−100.0 (2)	−140.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	5	
			−100.0 (2)	−142.13 (1)	OFF	ON	N/A	N/A	N/A	N/A	5	
7/8	D/L threshold two-way	3A	−145.0 (2)	−142.5 (1)	OFF	OFF	N/A	N/A	N/A	N/A	3B	
		3B	−145.0 (2)	−142.5 (1)	OFF	OFF	N/A	N/A	N/A	N/A	5B	
		3C	−145.0 (2)	−142.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	6B	
		3D	−145.0 (2)	−142.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	7B	
		3E	−145.0 (2)	−142.2 (1)	OFF	ON	N/A	N/A	N/A	N/A	3B/CMD	
		3F	−145.0 (2)	−119.8 (1)	OFF	ON	N/A	N/A	N/A	N/A	5B/CMD	
		3G	−145.0 (2)	−130.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
7/9	S/C RCVR pull in	4A	−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	−480 Hz	N/A	N/A	3	
			−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	+480 Hz	N/A	N/A	3	
	S/C range and rate		−100.0 (2)	−142.6 (1)	OFF	OFF	45	+63 kHz	N/A	N/A	3	
			−100.0 (2)	−142.0 (1)	OFF	OFF	45	−63 kHz	N/A	N/A	3	
	S/C rcvr acquisition and tracking rate		−100.0 (2)	−142.5 (1)	OFF	OFF	45	+63 kHz	N/A	N/A	3	
			−100.0 (2)	−142.0 (1)	OFF	OFF	45	−63 kHz	N/A	N/A	3	
	S/C pull in	4B	−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	−480 Hz	N/A	N/A	8	
			−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	+480 Hz	N/A	N/A	8	
	S/C range and rate		−100.0 (2)	−142.0 (1)	OFF	OFF	45	+63 kHz	N/A	N/A	8	
			−100.0 (2)	−142.0 (1)	OFF	OFF	45	−63 kHz	N/A	N/A	8	
	S/C rcvr acquisition and tracking rate		−100.0 (2)	−142.0 (1)	OFF	OFF	45	None	N/A	N/A	8	
			−100.0 (2)	−142.0 (1)	OFF	OFF	45	None	N/A	N/A	8	
7/10	Carrier residual phase jitter	5A	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3B	
			−100.0 dBm	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	3B	
			−100.0 dBm	−142.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	3B	
		5B	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5B	
			−100.0 dBm	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	5B	
			−100.0 dBm	−141.8 dBm	N/A	N/A	N/A	N/A	N/A	N/A	5B	
		5C	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6B	
			−100.0 dBm	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	6B	
			−100.0 dBm	−142.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	6B	
		5D	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7B	
			−100.0 dBm	−100.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	7B	
			−100.0 dBm	−142.0 dBm	N/A	N/A	N/A	N/A	N/A	N/A	7B	

Notes: 1. Ramped from −63 kHz acquired at rest frequency.
2. Ramped from +63 kHz acquired at rest frequency.
3. Ramped from −63 kHz acquired at rest frequency.
4. Ramped from +63 kHz acquired at rest frequency.

Table 1. DSN/Viking spacecraft test Lander compatibility test results

Spacecraft								Test data		Test time, min.	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	HI	N/A	1	OFF	A	2	−160.1 dBm	−160 ± 2 dBm	59	DSN RCV signal levels are
2	2	HI	N/A	2	OFF	A	2	−161.1 dBm	−160 ± 2 dBm	41	starting P_c levels.
1	2	HI	N/A	2	OFF	A	2	−160.8 dBm	−160 ± 2 dBm	31	
1	1	HI	N/A	1	OFF	A	1	−153.3 dBm	−150.3 ± 2.5 dBm	32	DSN EXC signal levels are
1	1	HI	N/A	1	OFF	A	1	−152.8 dBm	−150.3 ± 2.5 dBm		starting P_c levels.
1	2	HI	N/A	1	OFF	A	2	−152.4 dBm	−149.2 ± 2.5 dBm	57	
1	2	HI	N/A	1	OFF	A	2	−152.1 dBm	−149.2 ± 2.5 dBm		
1	1	HI	N/A	1	OFF	A	1	−161.9 dBm	−162 ± 2 dBm	37	DSN RCV signal levels are
1	2	HI	N/A	1	OFF	A	2	−161.4 dBm	−162 ± 2 dBm	38	starting P_c levels.
2	2	HI	N/A	2	OFF	A	2	−161.1 dBm	−162 ± 2 dBm	31	
1	2	HI	N/A	2	OFF	A	2	−162.2 dBm	−160 ± 2 dBm	44	
1	1	HI	N/A	1	OFF	A	1	−161.8 dBm	−162 ± 2 dBm	32	
1	2	HI	N/A	1	OFF	A	2	−162.1 dBm	−160 ± 2 dBm	31	
1	2	HI	N/A	1	OFF	A	2	−162.4 dBm	−160 ± 2 dBm	25	
1	1	HI	N/A	1	OFF	A	1	45 s	S/C rcvr must lock		
1	1	HI	N/A	1	OFF	A	1	6 s	to U/L.		
1	1	HI	N/A	1	OFF	A	1	+63.1 kHz	+63.0 kHz	150	
1	1	HI	N/A	1	OFF	A	1	−63.1 kHz	−63.0 kHz		
1	1	HI	N/A	1	OFF	A	1	Acq/trk to +63 kHz	Acq/trk to +63 kHz		See Note 1.
1	1	HI	N/A	1	OFF	A	1	Acq/trk to −63 kHz	Acq/trk to −63 kHz		See Note 2.
2	2	HI	N/A	1	OFF	A	2	6 s	S/C must lock		
2	2	HI	N/A	1	OFF	A	2	6 s	to U/L.		
2	2	HI	N/A	1	OFF	A	2	+63.2 kHz	+63.0 kHz	176	
2	2	HI	N/A	1	OFF	A	2	−63.0 kHz	−63.0 kHz		
2	2	HI	N/A	1	OFF	A	2	Acq/trk to +63 kHz	Acq/trk to +63 kHz		See Note 3.
2	2	HI	N/A	1	OFF	A	2	Acq/trk to −63 kHz	Acq/trk to −63 kHz		See Note 4.
1	1	HI	N/A	1	OFF	A	1	1.97 deg rms	5.0 deg rms		Blk III RCVR and EXC.
1	1	HI	N/A	1	OFF	A	1	3.0 deg rms	5.0 deg rms	60	
1	1	HI	N/A	1	OFF	A	1	14.68 deg rms	None given.		
1	2	HI	N/A	1	OFF	A	2	1.63 deg rms	5.0 deg rms		
1	2	HI	N/A	1	OFF	A	2	2.96 deg rms	5.0 deg rms	40	
1	2	HI	N/A	1	OFF	A	2	17.23 deg rms	None given.		
2	2	HI	N/A	2	OFF	A	2	1.28 deg rms	5.0 deg rms		Blk III RCVR and EXC.
2	2	HI	N/A	2	OFF	A	2	2.74 deg rms	5.0 deg rms	40	
2	2	HI	N/A	2	OFF	A	2	15.99 deg rms	None given.		
1	2	HI	N/A	2	OFF	A	2	1.69 deg rms	5.0 deg rms		
1	2	HI	N/A	2	OFF	A	2	3.56 deg rms	5.0 deg rms	39	
1	2	HI	N/A	2	OFF	A	2	17.52 deg rms	None given.		

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/9	D/L spectrum analysis	6A	−83.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	3B	
			−83.0 dBm	−140.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3B	
		6B	−83.0 dBm	−140.0 dBm	OFF	ON	N/A	N/A	N/A	N/A	3B/CMD	
		6C	−83.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	5B	
			−83.0 dBm	−120.9 dBm	OFF	OFF	N/A	N/A	N/A	N/A	5B	
		6D	−83.0 dBm	−120.7 dBm	OFF	ON	N/A	N/A	N/A	N/A	5B/CMD	
		6E	−83.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	6B	
			−83.0 dBm	−120.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6B	
		6F	−83.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	7B	
			−83.0 dBm	−120.5 dBm	OFF	OFF	N/A	N/A	N/A	N/A	7B	
		6G	Same as Test 15G. See 15G for results.									
7/10	False lock	7A	−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	+63 kHz	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	−63 kHz	N/A	N/A	N/A	
	U/L spectrum analysis spectrum sweep rate = 200 kHz		−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	ON	ON	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	N/A	
	Spectrum sweep rate = 10 MHz		−100.0 (2)	−120.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	ON	ON	N/A	N/A	N/A	N/A	N/A	
			−100.0 (2)	−120.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	N/A	
7/9	Transponder rest frequency	8A	−100.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	3	
			−100.0 (2)	−103.0 (1)	OFF	OFF	N/A	N/A	N/A	N/A	3	
		8B	−100.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	5	
			−100.0 (2)	−100.7 (1)	OFF	OFF	N/A	N/A	N/A	N/A	5	
7/10	Auxiliary oscillator frequency	9A	−100.0 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	5	
		9B	−100.2 (2)	N/A	OFF	OFF	N/A	N/A	N/A	N/A	6	
7/12	Command performance	10A	−100.0 (2)	−142.5 (1)	N/A	ON	N/A	N/A	N/A	N/A	3	
			−100.0 (2)	−144.5 (1)	N/A	ON	N/A	N/A	N/A	N/A	3	
		10B	This test was not performed. Test criteria and parameters are contained in Test 10C.									

Notes: 5. Lock obtained by approaching best lock frequency from a +63 kHz offset.
6. Lock obtained by approaching best lock frequency from a −63 kHz offset.

Table 1 (contd)

Spacecraft								Test data		Test time, min.	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	HI	N/A	1	OFF	A	1			40	Blk III RCVR and EXC. Photos were taken. There were no apparent spurious components.
1	2	HI	N/A	1	OFF	A	1				
1	2	HI	N/A	1	OFF	A	1	To be determined.	No spurious components.	15	
1	2	HI	N/A	1	OFF	A	2			29	
1	2	HI	N/A	1	OFF	A	2				
1	2	HI	N/A	1	OFF	A	2			11	Discrete Fourier analysis will be performed at a later date.
2	2	HI	N/A	2	OFF	A	2			30	
2	2	HI	N/A	2	OFF	A	2				
1	2	HI	N/A	2	OFF	A	2			21	
1	2	HI	N/A	2	OFF	A	2				
						A		No false lock. The bias doppler did equal 1 MHz whenever an in-lock indication existed.	No false lock. The bias doppler must equal 1 MHz whenever an in-lock condition exists.		See Note 5.
						A					See Note 6.
						A		To be determined.	No spurious components.	60	Photos were taken. There were no apparent spurious components.
						A					
1	1	HI	N/A	1	OFF	A	1	D/L VCO freq = 2112970.156 kHz	2112971.451 ± 30 kHz	51	S/C VCO temp = 14.33 mV at start, 13.88 mV at end.
1	1	HI	N/A	1	OFF	A	1	S/C locked to U/L.	S/C locked to U/L.		
1	2	HI	N/A	1	OFF	A	2	D/L VCO freq = 2112965.659 kHz	2112971.451 ± 30 kHz	61	S/C VCO temp = 14.69 mV at start, 14.06 mV at end.
1	2	HI	N/A	1	OFF	A	2	S/C locked to U/L.	S/C locked to U/L.		
1	2	HI	N/A	1	OFF	A	2	D/L VCO freq = 2294626.4 kHz	2294629.630 ± 20 kHz	44	S/C VCO temp = 14.33 mV at end, 14.42 mV at start.
2	2	HI	N/A	2	OFF	A	2	D/L VCO freq = 2294632.256 kHz	2994629.630 ± 20 kHz	46	S/C VCO temp = 14.06 mV at start, 13.88 mV at end.
1	1	HI	N/A	1	OFF	A	1	Ten 32-word cmds were successfully detected and executed by the S/C. Five 32-word cmds were successfully detected by the S/C.	All commands successfully detected and executed by the S/C.	121	

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/12	Command performance with and without ranging	10C	−100.0 (2)	−141.5 (1)	OFF	ON	N/A	N/A	N/A	N/A	5AR	
			−100.0 (2)	−141.5 (1)	ON	ON	N/A	N/A	N/A	N/A	5AR	
			−100.0 (2)	−144.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	5AR	
			−100.0 (2)	−143.5 (1)	ON	ON	N/A	N/A	N/A	N/A	5AR	
7/11	Command capability under doppler conditions	11A	−100.0 (2)	−142.5 (1)	OFF	ON	None	+20 kHz	N/A	N/A	3	
			−100.0 (2)	−143.0 (1)	OFF	ON	None	−20 kHz	N/A	N/A	3	
		11B	See Note 7.									
7/10	Ranging channel delay, threshold, and polarity verification	12A	−100.0 (2)	−100.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−120.2 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−120.2 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−120.2 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−120.2 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−130.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−130.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
			−135.0 (2)	−130.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	5AR	
7/11		12B	−99.5 (2)	−99.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	6AR	
			−135.0 (2)	−119.8 (1)	ON	OFF	N/A	N/A	N/A	N/A	6AR	
			−135.0 (2)	−129.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	6AR	
		12C	−100.5 (2)	−100.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	7AR	
			−135.0 (2)	−120.0 (1)	ON	OFF	N/A	N/A	N/A	N/A	7AR	
			−135.0 (2)	−129.5 (1)	ON	OFF	N/A	N/A	N/A	N/A	7AR	
7/11	Ranging acquisition and capability with doppler	13	−135.0 (2)	−120.0 (1)	ON	OFF	None	−20 kHz	N/A	N/A	5AR	
			−135.0 (2)	−130.5 (1)	ON	OFF	None	−20 kHz	N/A	N/A	5AR	
			−135.0 (2)	−120.5 (1)	ON	OFF	None	+20 kHz	N/A	N/A	5AR	
			−135.0 (2)	−130.0 (1)	ON	OFF	None	+20 kHz	N/A	N/A	5AR	
7/9	Modulation index and spectrum analyses	15A	Test 15A was not performed. Test criteria are contained in Test 6A.									
		15B	−83.0 (2)	OFF	OFF	OFF	N/A	N/A	N/A	N/A	3C	
			−83.0 (2)	−14.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	3C	
		15C	−83.0 (2)	OFF	OFF	OFF	N/A	N/A	N/A	N/A	3D	
			−83.0 (2)	−140.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	3D	
		15D	Test 15D was not performed. Test criteria are contained in Test 6E.									

Notes: 7. Command capability under doppler conditions. Test 11B was not performed. The test criteria contained in Test 11B were accomplished in Test 11A; therefore, 11B was deleted as an overtest. A waiver request to delete Test 11B from the MITP was approved during the VL-RF compatibility pretest review.

8. Zero-delay tests have yet to be performed. Thus, at this time, absolute spacecraft delay cannot be determined. Zero-delay tests will be run upon completion of the dual-spacecraft compatibility testing and the spacecraft delay verified.

Table 1 (contd)

Spacecraft								Test data		Test time, min.	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	HI	N/A	1	OFF	A	2	Ten 32-word cmds were successfully detected and executed by the S/C. Five 32-word cmds were successfully detected and executed by the S/C. Aborted one cmd.	All commands successfully detected and executed by the S/C.	201	The first of five 32-word cmds aborted. The remaining four 32-word cmds were successfully transmitted.
1	2	HI	N/A	1	OFF	A	2				
1	1	HI	N/A	1	OFF	A	1	All cmds sent were detected and executed by the S/C.	S/C detected and executed 2 cmd series. Ten 32-word cmds dropped lock, reacquired and performed. Five, 10-word cmds.	479	Cmd mod was turned off while at both the + and − offset. U/L was reacquired by the S/C with no problem.
1	1	HI	N/A	1	OFF	A	1			None	
1	2	HI	N/A	1	ON	A	2	5057.3 ns	See Note 9.		
1	2	HI	N/A	1	ON	A	2	5049.7 ns	See Note 9.		
1	2	HI	N/A	1	ON	A	2	5036.5 ns	See Note 10.		
1	2	HI	N/A	1	ON	A	2	5054.4 ns	See Note 11.	178	See Note 8.
1	2	HI	N/A	1	ON	A	2	5049.7 ns	See Note 12.		
1	2	HI	N/A	1	ON	A	2	5031.7 ns	See Note 13.		
1	2	HI	N/A	1	ON	A	2	5054.4 ns	See Note 12.		
1	2	HI	N/A	1	ON	A	2	5060.1 ns	See Note 14.		
2	2	HI	N/A	2	ON	A	2	5023.2 ns	See Note 9.		
2	2	HI	N/A	2	ON	A	2	5023.2 ns	See Note 12.	89	See Note 8.
2	2	HI	N/A	2	ON	A	2	5016.6 ns	See Note 15.		
1	2	HI	N/A	2	ON	A	2	5040.2 ns	See Note 9.		
1	2	HI	N/A	2	ON	A	2	5029.8 ns	See Note 12.	94	See Note 8.
1	2	HI	N/A	2	ON	A	2	5010.0 ns	See Note 15.		
1	2	HI	N/A	1	ON	A	2	5036.5 ns	See Note 12.		
1	2	HI	N/A	1	ON	A	2	5055.4 ns	See Note 15.	189	See Note 8.
1	2	HI	N/A	1	ON	A	2	5033.6 ns	See Note 12.		
1	2	HI	N/A	1	ON	A	2	5033.6 ns	See Note 15.		
1	1	HI	N/A	1	OFF	A	1			91	Photos were taken. There were no spurious components. Discrete Fourier analysis will be performed at a later date.
1	1	HI	N/A	1	OFF	A	1	To be determined.	No spurious components.		
1	1	HI	N/A	1	OFF	A	1			21	
1	1	HI	N/A	1	OFF	A	1				

9-15. Ranging parameters

	Note 9	Note 10	Note 11	Note 12	Note 13	Note 14	Note 15
Discrete spectrum components	15	15	15	15	15	15	15
Continuous spectrum code	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Clock acquisition time	10	15	20	30	25	35	40
Code component acquisition time	1	2	3	5	5	10	10
DRVID averaging time	10	15	20	30	25	35	40

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/9	Modulation index and spectrum analyses (continued)	15E	−83.0 (2)	OFF	OFF	OFF	N/A	N/A	N/A	N/A	6C	
			−83.0 (2)	−139.5 (1)	OFF	ON	N/A	N/A	N/A	N/A	6C	
		15F	−83.0 (2)	OFF	OFF	OFF	N/A	N/A	N/A	N/A	6D	
			−83.0 (2)	−140.0 (1)	OFF	ON	N/A	N/A	N/A	N/A	6D	
		15G	−83.0 (2)	OFF	OFF	OFF	N/A	N/A	N/A	N/A	6D	
			−83.0 (2)	−141.1 (1)	OFF	ON	N/A	N/A	N/A	N/A	6D	
7/10	Telemetry performance	16A	Y-factor = 6.77 −134 dBm	−142.6 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3B	
			Y-factor = 4.6 −137.5 dBm	−142.6 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3B	
			−137.5 dBm	−142.6 dBm	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	3B	
			−137.5 dBm	−142.5 dBm	OFF	OFF	45	−20 kHz	N/A	−2.125 Hz −0.350 Hz	3B	
			−137.5 dBm	N/A	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	3B	
7/11		16B	Y-factor = 6.77 −134 dBm	−142.5 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3C	
			Y-factor = 4.6 −137.5 dBm	−142.5 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3C	
			−137.5 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	3C	
		16C	Y-factor = 6.77 −134 dBm	−142.5 dBm	OFF	OFF	N/A	N/A	N/A	N/A	3D	
			−134 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	3D	
7/12		16D (A)	Y-factor = 13.723 −140 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6B	
			−140.5 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	6B	
			−140.5 dBm	−120 dBm	OFF	OFF	250	−20 kHz	N/A	−2.125 Hz −0.350 Hz	6B	
			−140.1 dBm	N/A	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	6B	

Table 1 (contd)

Spacecraft								Test data				
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance		Criteria	Test time, min.	Test comments
2	2	HI	N/A	2	OFF	A	2					Photos were taken. There were
2	2	HI	N/A	2	OFF	A	2				18	no spurious components.
2	2	HI	N/A	2	OFF	A	2				18	Discrete Fourier analysis will
2	2	HI	N/A	2	OFF	A	2	To be determined.		No spurious components.		be performed at a later date.
2	2	HI	N/A	2	OFF	A	2				40	
2	2	HI	N/A	2	OFF	A	2					
1	1	HI	N/A	1	OFF	A	1	12.1 dB	HR	10.9 ± 1.5 dB		250 bps coded HR.
								17.56 dB	LR	17.7 ± 1.5 dB		8.33 bps coded LR.
1	1	HI	N/A	1	OFF	A	1	9.0 dB	HR	7.9 ± 1.5 dB		
								15.6 dB	LR	14.7 ± 1.5 dB		
1	1	HI	N/A	1	OFF	A	1	9.0 dB	HR	7.9 ± 1.5 dB	84	SDAs offset.
								15.6 dB	LR	14.7 ± 1.5 dB		
1	1	HI	N/A	1	OFF	A	1	8.5 dB	HR	7.9 ± 1.5 dB		SDAs offset and doppler.
								15.71 dB	LR	14.7 ± 1.5 dB		
1	1	HI	N/A	1	OFF	A	1	9.25 dB	HR	7.9 ± 1.5 dB		One-way mode.
								15.82 dB	LR	14.7 ± 1.5 dB		
1	1	HI	N/A	1	OFF	A	1	9.0 dB	HR	7.9 ± 1.5 dB		500 bps coded HR.
								17.7 dB	LR	17.7 ± 1.5 dB		8.33 bps coded LR.
1	1	HI	N/A	1	OFF	A	1	6.0 dB	HR	4.9 ± 1.5 dB		
								16.25 dB	LR	14.7 ± 1.5 dB		One-way mode.
1	1	HI	N/A	1	OFF	A	1	6.0 dB	HR	4.9 ± 1.5 dB	40	
								15.9 dB	LR	14.7 ± 1.5 dB		
1	1	HI	N/A	1	OFF	A	1	6.0 dB	HR	4.9 ± 1.5 dB		1000 bps coded HR.
								17.6 dB	LR	17.7 ± 1.5 dB	30	8.33 bps coded LR.
1	1	HI	N/A	1	OFF	A	1	6.0 dB	HR	4.9 ± 1.5 dB		One-way mode.
								18.4 dB	LR	17.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	4.85 dB	HR	This was an additional		250 bps coded HR.
										test. The criteria were		8.33 bps coded LR.
								12.05 dB	LR	established as	105	SDAs offset.
2	2	HI	N/A	2	OFF	A	2	3.94 dB	HR	4.9 ± 1.5 dB(HR)		SDAs offset and doppler.
								11.85 dB	LR	12.7 ± 1.5 dB(HR)		
2	2	HI	N/A	2	OFF	A	2	4.86 dB	HR	for each element of this		One-way mode.
								12.38 dB	LR	test.		
2	2	HI	N/A	2	OFF	A	2	4.58 dB	HR			
								11.85 dB	LR			

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/10	Telemetry performance (continued)	16D	Y-factor = 6.77 −135.0 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6B	
			Y-factor = 4.6 −137.5 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6B	
			−137.5 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	6B	
			−137.5 dBm	−120.5 dBm	OFF	OFF	250	−20 kHz	N/A	−2.125 Hz −0.350 Hz	6B	
			−137.5 dBm	N/A	OFF	OFF	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	6B	
7/10		16E	Y-factor = 6.77 −134 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6C	
			Y-factor = 4.6 −136 dBm	−120 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6C	
			−136 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	6C	
7/10		16F	Y-factor = 6.77 −134 dBm	−120.5 dBm	OFF	OFF	N/A	N/A	N/A	N/A	6D	
			−134 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	6D	
7/11		16G	Y-factor = 4.63 −137.5 dBm	−128.5 dBm	ON	OFF	N/A	N/A	N/A	N/A	5A	
			−137.5 dBm	−128.5 dBm	ON	OFF	N/A	N/A	N/A	−0.350 Hz	5A	
			−137.5 dBm	−128.5 dBm	ON	OFF	100	−20 kHz	N/A	−0.350 Hz	5A	

Table 1 (contd)

Spacecraft								Test data			Test time, min	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance		Criteria		
2	2	HI	N/A	2	OFF	A	2	11.1 dB	HR	10.9 ± 1.5 dB		250 bps coded HR.
								16.8 dB	LR	17.7 ± 1.5 dB		8.33 bps coded LR.
2	2	HI	N/A	2	OFF	A	2	8.5 dB	HR	7.9 ± 1.5 dB		
								15.2 dB	LR	14.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	8.5 dB	HR	7.9 ± 1.5 dB	110	SDAs offset.
								15.3 dB	LR	14.7 ± 1.5 dB		SDAs offset and doppler.
2	2	HI	N/A	2	OFF	A	2	8.1 dB	HR	7.9 ± 1.5 dB		One-way mode.
								15.6 dB	LR	14.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	8.1 dB	HR	7.9 ± 1.5 dB		
								14.77 dB	LR	14.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	8.5 dB	HR	7.9 ± 1.5 dB		500 bps coded HR.
								17.7 dB	LR	17.7 ± 1.5 dB		8.33 bps coded LR.
2	2	HI	N/A	2	OFF	A	2	6.29 dB	HR	4.9 ± 1.5 dB	55	
								16.08 dB	LR	14.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	6.5 dB	HR	4.9 ± 1.5 dB		One-way mode.
								16.25 dB	LR	14.7 ± 1.5 dB		
2	2	HI	N/A	2	OFF	A	2	5.4 dB	HR	4.9 ± 1.5 dB		1000 bps coded HR.
								17.8 dB	LR	17.7 ± 1.5 dB		8.33 bps coded LR.
2	2	HI	N/A	2	OFF	A	2	5.4 dB	HR	4.9 ± 1.5 dB	31	One-way mode.
								17.65 dB	LR	17.7 ± 1.5 dB		
1	2	HI	N/A	1	ON	A	2	20.95 dB		20.8 ± 1.5 dB		8.33 LR only.
											50	
1	2	HI	N/A	1	ON	A	2	20.05 dB		20.8 ± 1.5 dB		
1	2	HI	N/A	1	ON	A	2	19.9 dB		20.8 ± 1.5 dB		

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset, Hz	SDA SUBC offset, Hz	Mode	RM
6/26	D/L threshold one-way	1A	Blk III RCV 2	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1A	304
6/27		1B	Blk IV RCV 3	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1A	312
6/30		1C	Blk IV RCV 3	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1A	204
6/28		1D	Blk III RCV 2	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16A	370
6/28		1E	Blk IV RCV 3	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16A	370
7/2		1F	Blk IV RCV 3	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16A	374
6/26	U/L threshold	2A	−107.0 dBm	−140.0 dBm Starting level	OFF	OFF	N/A	N/A	N/A	N/A	1	304
					OFF	ON	N/A	N/A	N/A	N/A	1	
					ON	OFF	N/A	N/A	N/A	N/A	1	
					ON	ON	N/A	N/A	N/A	N/A	1	
		2B	−107.0 dBm	−140.0 dBm Starting level	OFF	OFF	N/A	N/A	N/A	N/A	2	376
					OFF	ON	N/A	N/A	N/A	N/A	2	
					ON	OFF	N/A	N/A	N/A	N/A	2	
					ON	ON	N/A	N/A	N/A	N/A	2	
6/27	D/L threshold two-way	3A	Blk III RCV 2	−129.8 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1A	302
6/27		3B	Blk IV RCV 3	−129.8 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1A	302
6/30		3C	Blk IV RCV 3	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1A	304
6/27		3D	Blk III RCV 2	−129.8 dBm	ON	OFF	N/A	N/A	N/A	N/A	1AR	303
6/28		3E	Blk IV RCV 3	−129.8 dBm	ON	OFF	N/A	N/A	N/A	N/A	1AR	303
6/30		3F	Blk IV RCV 3	−131.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1AR	305
6/28		3G	Blk III RCV 2	−130.5 dBm	OFF	ON	N/A	N/A	N/A	N/A	1A/CMD	302
6/28		3H	Blk III RCV 2	−130.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	16A	370
6/26	S/C rcvr pull in	4A	−107.0 dBm	−110.0 dBm	OFF	OFF	N/A	+500 Hz	N/A	N/A	1	304
	S/C rcvr pull in		Blk III RCV 2	−110.0 dBm	OFF	OFF	N/A	−500 Hz	N/A	N/A	1	
	S/C rcvr range and rate			−120.0 dBm	OFF	OFF	500	+40 kHz	N/A	N/A	1	
	S/C rcvr range and rate			−120.0 dBm	OFF	OFF	500	−40 kHz	N/A	N/A	1	
	S/C rcvr acquisition and tracking rate			−120.0 dBm	OFF	OFF	500	+ 7 kHz	N/A	N/A	1	
	S/C rcvr acquisition and tracking rate			−120.0 dBm	OFF	OFF	500	− 7 kHz	N/A	N/A	1	
6/26	S/C rcvr pull in	4B	−107.0 dBm	−110.0 dBm	OFF	OFF	N/A	+500 Hz	N/A	N/A	2	376
	S/C rcvr pull in		Blk III RCV 2	−110.0 dBm	OFF	OFF	N/A	−500 Hz	N/A	N/A	2	
	S/C rcvr range and rate			−120.0 dBm	OFF	OFF	500	+40 kHz	N/A	N/A	2	
	S/C rcvr range and rate			−120.0 dBm	OFF	OFF	500	−40 kHz	N/A	N/A	2	
	S/C rcvr acquisition and tracking rate			−120.0 dBm	OFF	OFF	500	+ 7 kHz	N/A	N/A	2	
	S/C rcvr acquisition and tracking rate			−120.0 dBm	OFF	OFF	500	− 7 kHz	N/A	N/A	2	
7/2	Carrier residual phase jitter	5A	− 99.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1A	304
			− 99.0 dBm	− 75.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1A	
			− 99.0 dBm	−130.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1A	
		5B	−100.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16A	374
			−100.0 dBm	− 70.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	16A	
			−100.0 dBm	−130.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	16A	
6/27	U/L spectrum and false lock	6A	Blk III RCV 2	−115.5 dBm	OFF	OFF	15	±2 kHz	N/A	N/A	1	300
		6B	Blk III RCV 2	−112.0 dBm	OFF	OFF	15	±2 kHz	N/A	N/A	2	372
6/28	D/L spectrum analysis	7A	Blk III RCV 1,2	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1A	300
			−110.0 dBm	−115.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1A/1AR	300/301
		7B	Test not performed.									
6/28		7C	Blk III RCV 1,2	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16A	370
			−110.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	16A	370
			−110.0 dBm	−115.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	16AR	371

Table 2. DSN/Viking proof test Orbiter compatibility test results

Spacecraft								Test data		Test time, min	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	HI	HI	1	OFF	1	1	−160.1 dBm	−158.0 ± 2 dBm	34	None.
1	2	LO	LO	1	OFF	1	1	−161.0 dBm	TBD	10	S-band test.
1	1	HI	HI	1	OFF	1	1	−146.2 dBm	−145.0 ± 3 dBm	5	X-band test.
2	2	LO	HI	2	OFF	2	2	−156.3 dBm	−158.0 ± 2 dBm	16	None.
2	2	LO	HI	2	OFF	2	2	−159.0 dBm	TBD	30	S-band test.
2	2	HI	HI	2	OFF	2	2	−147.8 dBm	−145.0 ± 3 dBm	45	X-band test.
1	1	HI	HI	1	OFF	1	1	−154.5 dBm	−152.3 ± 2 dBm	70	RCVR2, EXC 1.
								−154.0 dBm	−152.3 ± 2 dBm		
								−154.0 dBm	−152.3 ± 2 dBm		
								−154.5 dBm	−152.3 ± 2 dBm		
2	2	HI	LO	2	OFF	2	2	−155.0 dBm	−151.8 ± 2 dBm	70	RCVR2, EXC 1.
								−155.5 dBm	−151.8 ± 2 dBm		
								−156.0 dBm	−151.8 ± 2 dBm		
								−154.0 dBm	−151.8 ± 2 dBm		
1	1	LO	LO	1	OFF	1	1	−159.2 dBm	−158.0 ± 2 dBm	38	EXC1 used all tests.
1	1	LO	LO	1	OFF	1	1	−160.0 dBm	TBD	28	S-band test.
1	1	HI	HI	1	OFF	1	1	−148.8 dBm	TBD	28	X-band test.
1	1	LO	LO	1	ON	1	1	−159.8 dBm	−158.0 ± 2 dBm	21	None.
1	1	LO	LO	1	ON	1	1	−160.8 dBm	TBD	28	S-band test.
1	1	HI	HI	1	ON	1	1	−148.3 dBm	TBD	25	X-band test.
1	1	LO	LO	1	OFF	1	1	−160.0 dBm	−158.0 ± 2 dBm	34	None.
2	2	LO	HI	2	OFF	2	2	−155.2 dBm	−158.0 ± 2 dBm	28	None.
1	1	HI	HI	1	OFF	1	1	5.0 s	<60 s	69	None.
								3.0 s	<60 s		
								+40.0 kHz	+40.0 kHz		
								−40.0 kHz	−40.0 kHz		
								Acq/trk	Acq/trk to +7 kHz		
								Acq/trk	Acq/trk to −7 kHz		
2	2	HI	LO	2	OFF	2	2	21.0 s	<60 s	30	None.
								7.0 s	<60 s		
								+40.2 kHz	+40.0 kHz		
								−39.9 kHz	−40.0 kHz		
								Acq/trk	Acq/trk to +7 kHz		
								Acq/trk	Acq/trk to −7 kHz		
1	1	HI	HI	1	OFF	1	1	2.58 deg rms	<3.6 deg rms	71	EXC 1.
								2.69 deg rms	<2.8 deg rms		
								10.22 deg rms	TBD		
2	2	HI	HI	2	OFF	2	2	1.39 deg rms	<3.6 deg rms	60	EXC 1.
								2.69 deg rms	<2.8 deg rms		
								10.55 deg rms	TBD		
1	1	LO	HI	1	OFF	1	1	No false lock	No false lock	44	Photos of U/L taken.
2	2	LO	LO	2	OFF	2	2	No false lock	No false lock	47	
1	1	LO	HI	1	OFF	1	1	TBD	No spurious components	61	Photos of D/L taken show no apparent spurious components.
1	1	LO	HI	1	OFF/ON	1	1				
2	2	LO	HI	2	OFF	2	2			38	Fourier analysis will be provided at a later time.
2	2	LO	HI	2	OFF	2	2				
2	2	LO	HI	2	ON	2	2				

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset, Hz	SDA SUBC offset, Hz	Mode	RM
		7D	Test not performed.									
7/10		7E	− 90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	9G	324
7/10		7F	−93.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	10K	344
7/3		7G	−106.0 dBm	−115.0 dBm	ON	ON	N/A	N/A	N/A	N/A	1FR/CMD	305
6/28		7H	Blk III RCV 1,2	N/A	OFF	OFF	N/A	N/A	N/A	N/A	2A	372
			−110.0 dBm	−126.5 dBm	ON	ON	N/A	N/A	N/A	N/A	2AR/CMD	373
6/26	Transponder rest frequency	8A	−107.0 dBm	−140.3 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1	304
		8B	−108.5 dBm	−140.3 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2	376
6/28	Auxiliary oscillator frequency	9A	−110.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	1	200
		9B	−110.0 dBm	N/A	OFF	OFF	N/A	N/A	N/A	N/A	16	370
7/1	Command performance w/wo ranging	10A	−110.0 dBm	−142.5 dBm	OFF	ON	N/A	N/A	N/A	N/A	1	304
			−110.0 dBm	−142.5 dBm	ON	ON	N/A	N/A	N/A	N/A	1R	305
		10B	−110.0 dBm	−142.0 dBm	OFF	ON	N/A	N/A	N/A	N/A	2	376
			−110.0 dBm	−142.0 dBm	ON	ON	N/A	N/A	N/A	N/A	2R	377
6/29	Command capability under doppler	11A	−100.0 dBm	−130.0 dBm	OFF	ON	N/A	±40 kHz	±0.10	N/A	1	304
		11B	−109.5 dBm	−129.5 dBm	OFF	ON	N/A	±40 kHz	±0.10	N/A	2	376
7/1	Ranging delay, threshold, and polarity	12A	−116.0 dBm	−108.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1FR	305
			−136.0 dBm	−137.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1FR	305
7/2		12B	−115.0 dBm	−108.0 dBm	ON	ON	N/A	N/A	N/A	N/A	16FR	375
			−134.0 dBm	−137.0 dBm	ON	ON	N/A	N/A	N/A	N/A	16FR	375
7/2		12C	−131.0 dBm	−108.5 dBm	ON	ON	N/A	N/A	N/A	N/A	2AR	377
			−136.0 dBm	−137.5 dBm	ON	ON	N/A	N/A	N/A	N/A	2AR	377
7/3		12D	−112.0 dBm	−106.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1R	305
7/1	Ranging acquisition capability with doppler	13A	−107.0 dBm	−107.5 dBm	ON	ON	N/A	−40 kHz	N/A	N/A	1FR	305
			−137.0 dBm	−118.0 dBm	ON	ON	N/A	−40 kHz	N/A	N/A	1FR	305
7/2		13B	−117.0 dBm	−108.5 dBm	ON	ON	N/A	−40 kHz	N/A	N/A	16FR	375
			−137.0 dBm	−118.0 dBm	ON	ON	N/A	−40 kHz	N/A	N/A	16FR	375
7/12	DRVID test	14	−116.0 dBm	−108.0 dBm	ON	ON	N/A	N/A	N/A	N/A	1FR	301
6/30	Modulation index and spectrum analysis	15A	Blk III RCV 1,2	−115.0 dBm	OFF/ON	OFF	N/A	N/A	N/A	N/A	1F/1FR	304/305
7/2		15B	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2E	376
7/2		15C	−90.0 dBm	−115.0 dBm	OFF/ON	OFF	N/A	N/A	N/A	N/A	2A/2AR	376/377
6/30		15D	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1S	304
7/24		15E	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	14A	336
7/24		15F	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	13P	306
7/10		15G	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	12W	354
6/30		15H	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1U	304
6/30		15I	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1N	304
7/6		15J	−90.0 dBm	−100.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	11V	330
7/10		15K	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	9G	324
7/10		15L	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	10K	334
7/6		15M	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2H	332
7/6		15N	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2Q	332
		15O	Test not performed.									
6/30		15P	−90.0 dBm	−115.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1M	304

Notes:
1. Spacecraft VCO drift prevented normal acquisition on average of 30-min runs.
2. Test was performed with command modulation off.
3. Spacecraft range delay could not be determined. The zero-delay measurements were not performed due to spacecraft configuration in the chamber. Relative delay measurements may be determined by calculating the spacecraft cable configuration. This step has not been accomplished yet. All acquisitions good.

Table 2 (contd)

Spacecraft								Test data		Test time, min	Test comments
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
2	1	HI	HI	1	OFF	1	1				Tests 7B and 7D were
1	1	HI	HI	2	OFF	2	1			46	not performed because
1	1	HI	HI	1	ON	1	1			43	of insufficient gain from
2	2	LO	LO	2	OFF	2	2			20	Blk IV coupled with
2	2	LO	LO	2	ON	2	2			39	excessive X-band RF loss.
1	1	HI	HI	1	OFF	1	1	505 s	<30 s	149	See Note 1.
2	2	HI	LO	2	OFF	2	2	66 s	<30 s	140	
1	1	LO	HI	1	OFF	1	1	23.366177 MHz	N/A	36	Readings are D/L
2	2	LO	HI	2	OFF	2	2	23.366268 MHz	N/A	38	frequency.
1	1	HI	HI	1	OFF	1	1	S/C verified all cmds	S/C verified all cmds	90	None.
1	1	HI	HI	1	ON	1	1	S/C verified all cmds	S/C verified all cmds		Acquired ranging code.
2	2	HI	LO	2	OFF	2	2	S/C verified all cmds	S/C verified all cmds	182	None.
2	2	HI	LO	2	ON	2	2	S/C verified all cmds	S/C verified all cmds		Acquired ranging code.
1	1	HI	HI	1	OFF	1	1	S/C verified all cmds	S/C verified all cmds	52	None.
2	2	HI	LO	2	OFF	2	2	S/C verified all cmds	S/C verified all cmds	115	
1	1	HI	HI	1	ON	1	1	5451 RU, ns	980 ± 180 ns	93	See Note 2.
1	1	HI	HI	1	ON	1	1	5445 RU, ns	980 ± 180 ns		See Note 3.
2	2	HI	HI	2	ON	2	2	5446 RU, ns	1000 ± 100 ns	63	All good acquisitions.
2	2	HI	HI	2	ON	2	2	5476 RU, ns	1000 ± 100 ns		
2	2	HI	LO	2	ON	2	2	5450 RU, ns	1000 ± 180 ns	56	Good acquisitions.
2	2	HI	LO	2	ON	2	2	5443 RU, ns	1000 ± 180 ns		6G, 4B acquisitions.
1	1	HI	HI	1	ON	1	1	5064 RU, ns	TBD	30	X-band, Blk IV RCV.
1	1	HI	HI	1	ON	1	1	5448 RU, ns	980 ± 180 ns	37	None.
1	1	HI	HI	1	ON	1	1	5454 RU, ns	980 ± 180 ns		All good acquisitions.
2	2	HI	HI	2	ON	2	2	5452 RU, ns	980 ± 180 ns	49	None.
2	2	HI	HI	2	ON	2	2	5455 RU, ns	980 ± 180 ns		All good acquisitions.
1	1	LO	HI	1	ON	1	1	<1 ns	< 108 ns	480	3-sigma variations.
1	1	HI	HI	1	OFF/ON	1	1	TBD	Verify modification	55	Photographs taken of all
2	2	HI	LO	2	OFF	2	2		indices	28	spectrums.
2	2	HI	LO	2	OFF/ON	2	2			39	Discrete Fourier
1	1	HI	HI	1	OFF	1	1			22	analysis of baseband
2	2	HI	LO	1	OFF	2	2			91	telemetry spectrum will
1	1	HI	LO	1	OFF	2	2			24	be performed later.
1	2	HI	HI	2	OFF	1	2			25	
1	1	HI	HI	1	OFF	1	1			37	
1	1	HI	HI	1	OFF	1	1			18	
2	2	LO	HI	1	OFF	1	2			29	
2	1	HI	HI	1	OFF	1	1			46	
1	1	HI	HI	2	OFF	2	1			43	
2	2	LO	LO	1	OFF	2	2			29	
2	2	LO	LO	1	OFF	2	2			22	
1	1	HI	HI	1	OFF	1	1			18	

Test date (1974)	Test title	Test No.	Deep Space Network									
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset, Hz	SDA SUBC offset, Hz	Mode	RM
7/6	Telemetry performance	16A	Y-factor = 10.05	EXC 1	OFF	OFF	N/A	N/A	N/A	N/A	2A	332
			Y-factor = 10.05	−138.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	2AR	333
			Y-factor = 12.64		OFF	OFF	N/A	N/A	N/A	N/A	2A	332
			Y-factor = 12.64		OFF	OFF	13	36.8 kHz	N/A	+0.22	2A	332
			Y-factor = 12.64		OFF	OFF	N/A	36.8 kHz	N/A	+0.22	2A	332
6/30	Telemetry performance (continued)	16B	Y-factor = 9.62	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1N	304
7/24		16C	Y-factor = 9.62	−125.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1N	304
7/24		16D	Y-factor = 8.46	−136.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	14A	336
7/10		16E	Y-factor = 6.42	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	12W	354
7/10		16F	Y-factor = 6.93	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	9G	324
		16G	Test not performed.									
7/4		16H	Y-factor = 4.91	−138.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2H	332
7/24		16I	Y-factor = ST/NO = 6.2	−126.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	13P	306
6/30		16J	Y-factor = 6.42	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1S	304
7/2		16K	Y-factor = 10.48	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2E	376
6/30		16L	Y-factor = 9.53	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1U	304
			Y-factor = 6.57	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1U	304
7/24		16M	Y-factor = 9.71	−126.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1U	304
			Y-factor = 6.57	−126.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1U	304
7/24		16N	Y-factor = 12.52	−125.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	2Q	336
7/3		16O	Y-factor = 4.83	−125.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1F	304
			Y-factor = 4.83	−127.0 dBm	ON	OFF	N/A	N/A	N/A	N/A	1FR	305
7/10	Telemetry performance (continued)	16P	Y-factor = 10.74	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	10K	344
			Y-factor = 6.34	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	10K	344
7/6		16Q	Y-factor = 12.33	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	11V	330
			Y-factor = 6.8	−127.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	11V	330
7/24		16R	Y-factor = 7.55	−125.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1M	304
			Y-factor = 7.55	−125.0 dBm	OFF	OFF	N/A	N/A	N/A	N/A	1M	304
			Y-factor = 7.55	−125.0 dBm	OFF	OFF	25.8	36.8 kHz	N/A	+2.20 +0.22	1M	304

Note: 4. Strong SNR due to multipath addition from low-gain antenna cabling.

Table 2 (contd)

Spacecraft								Test data			
EXC	RCVR	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria	Test time, min	Test comments
2	2	LO	LO	1	OFF	2	2	LR = 6.4 dB	LR = 6.3 ± 1.6 dB	339	Blk III, RCV 2 Used for all tests except 16C, 16M, 16Q.
2	2	LO	LO	1	ON	2	2	LR = 5.45 dB	LR = 5.4 ± 1.8 dB		
2	2	LO	LO	1	OFF	2	2	LR = 9.5 dB	LR = 8.6 ± 1.6 dB		
2	2	LO	LO	1	OFF	2	2	LR = 8.8 dB	LR = 7.7 ± 2.0 dB		
2	2	LO	LO	1	OFF	2	2	LR = 9.6 dB	LR = 8.5 ± 1.8 dB		
1	1	HI	HI	1	OFF	1	1	HR = 3.40 dB	HR = 3.2 ± 0.9 dB	33	
								LR = 9.20 dB	LR = 8.8 ± 2.6 dB		
1	1	HI	HI	1	OFF	1	1	HR = 2.60 dB	HR = 3.2 ± 0.9 dB	39	Blk IV, RCV 3.
								LR = 8.80 dB	LR = 8.8 ± 2.6 dB		
2	2	HI	LO	1	OFF	2	2	LR = 5.00 dB	LR = 4.5 ± 1.6 dB	25	
1	2	HI	HI	2	OFF	1	2	HR = 6.20 dB	HR = 5.4 ± 0.9 dB	54	5.85 with low-gain antenna terminated in load (see Note 4).
								LR = 6.05 dB	LR = 5.5 ± 2.6 dB		
2	1	HI	HI	1	OFF	1	1	HR = 3.60 dB	HR = 3.3 ± 0.9 dB	41	
								LR = 12.10 dB	LR = 11.7 ± 2.6 dB		
2	2	LO	LO	1	OFF	2	2	LR = 4.50 dB	LR = 5.6 ± 1.6 dB	54	
1	1	HI	LO	1	OFF	2	2	HR = 5.94 dB	HR = 5.1 ± 1.0 dB	43	
								LR = 6.34 dB	LR = 6.2 ± 2.8 dB		
1	1	HI	HI	1	OFF	1	1	HR = 6.00 dB	HR = 5.4 ± 0.9 dB	58	
								LR = 10.75 dB	LR = 11.3 ± 2.6 dB		
2	2	HI	LO	2	OFF	2	2	HR = 3.40 dB	HR = 3.3 ± 1.0 dB	52	
								LR = 6.23 dB	LR = 6.6 ± 2.8 dB		
1	1	HI	HI	1	OFF	1	1	HR = 5.62 dB	HR = 5.1 ± 0.9 dB	44	
1	1	HI	HI	1	OFF	1	1	HR = 11.98 dB	HR = 11.5 ± 0.9 dB		
								LR = 5.90 dB	LR = 5.8 ± 2.6 dB		
1	1	HI	HI	1	OFF	1	1	HR = 5.30 dB	HR = 5.1 ± 0.9 dB	42	Blk IV, RCV 3.
1	1	HI	HI	1	OFF	1	1	HR = 11.50 dB	HR = 11.5 ± 0.9 dB		
								LR = 5.67 dB	LR = 5.8 ± 2.6 dB		
2	2	HI	LO	1	OFF	2	2	HR = 5.80 dB	HR = 5.5 ± 1.0 dB	65	
								LR = 8.53 dB	LR = 8.8 ± 2.8 dB		
1	1	HI	HI	1	OFF	1	1	HR = 3.50 dB	HR = 3.3 ± 0.9 dB	98	
								LR = 9.10 dB	LR = 8.9 ± 2.6 dB		
1	1	HI	HI	1	ON	1	1	HR = 1.68 dB	HR = 2.4 ± 1.1 dB		
								LR = 8.20 dB	LR = 8.0 ± 2.8 dB		
1	1	HI	HI	2	OFF	2	1	HR = 3.75 dB	HR = 3.3 ± 1.0 dB	110	
1	1	HI	HI	2	OFF	2	1	HR = 8.85 dB	HR = 7.7 ± 0.9 dB		+.25 dB out of tolerance.
								LR = 6.27 dB	LR = 5.8 ± 2.8 dB		
2	2	LO	HI	1	OFF	1	2	HR = 5.80 dB	HR = 5.5 ± 0.9 dB	64	Performed with Blk IV RCV.
2	2	LO	HI	1	OFF	1	2	HR = 9.10 dB	HR = 8.9 ± 0.9 dB		
								LR = 5.55 dB	LR = 5.7 ± 2.6 dB		
1	1	HI	HI	1	OFF	1	1	HR = 4.00 dB	HR = 4.0 ± 0.9 dB	151	
								LR = 7.26 dB	LR = 6.4 ± 2.6 dB		Narrow-bandwidth LR.
1	1	HI	HI	1	OFF	1	1	LR = 7.10 dB	LR = 6.1 ± 2.6 dB		Medium-bandwidth LR.
1	1	HI	HI	1	OFF	1	1	HR = 3.85 dB	HR = 3.8 ± 1.0 dB		
								LR = 6.63 dB	LR = 5.6 ± 2.9 dB		

Test date (1974)	Test title	Test No.	Deep Space Network						
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset
7/27	False U/L RF acquisition with ranging	1	−137.5(2) −130.5(1) −111.0(3) −137.5(2) −130.5(1) −111.0(3)	−117.0(1) N/A −128.5(2) −117.0(1) N/A −128.5(2)	ON(1) N/A OFF(2) ON(1) N/A OFF(2)	OFF OFF 	13 EXC 1 NO 	(72.623 kHz) 2112.894097 MHz EXC 1 (72.623 kHz) 2112.894097 MHz EXC 1	N/A N/A N/A N/A N/A N/A
7/27	False command acquisition with ranging	2	−135.5(2) −131.8(1) −111.0(3)	N/A N/A −113.0(1)	N/A N/A ON(1)	N/A N/A ON(1)	NO	−10.055 kHz −2115.348690 MHz EXC 1	N/A
7/27	Command and telemetry degradation with ranging	3	−137.0(2) −131.8(1) −111.0(3)	−117.5(2) −123.0(1) N/A	ON(2) OFF(1) N/A	OFF(2) ON(1) N/A	1 EXC 2	2112.894347 MHz EXC 2	N/A
7/29	Radio metric degradation with ranging	4	−137.0(2) −132.0(1) −116.0(3)	−108.0(2) −120.0(1) N/A	ON(2) ON(1) N/A	OFF(2) OFF(1) N/A	1 EXC 2	2112.894447 MHz EXC 2 75.888 kHz	N/A
7/29	VL telemetry degradation by VO HRT	5	−137.0(2) −132.0(1) −116.0(3)	−120.0(1) −121.5(2) N/A	OFF	OFF	N/A	N/A	N/A
		5	−137.0(2) −132.0(1) −116.0(3)	−120.0(1) −121.5(2) N/A	OFF	OFF	N/A	2111.634558 MHz +28.75 kHz (2)	N/A
			−137.0(2) −132.0(1) −116.0(3)	−120.0(1) −121.5(2) N/A	OFF	OFF	N/A	2111.656658 MHz +50.732 kHz (2)	N/A
7/29	Multiple S/C telemetry performance	6	−137.0(2) −134.5(1) −118.5(3)	−121.5(1) −111.5(2) N/A	OFF(1) ON(2) N/A	OFF	N/A	N/A	N/A
			−137.0(2) −134.5(1) −118.5(3)	−121.5(1) −111.5(2) N/A	OFF(1) ON(2) N/A	OFF	250 (1) 13 (2)	+20 kHz	N/A

Table 3. DSN/Viking PTO/SCTL compatibility test results

Spacecraft				Test data			Test time, min	Test comments
SDA SUBC offset	Mode	RM	S/C	Performance		Criteria		
N/A N/A N/A N/A N/A N/A	5AR 1F TLM-G 5AR 1F TLM-G	304 304 	Lander Orbiter Test XMTR Lander Orbiter Test XMTR	No false RF and CDU acquisition with ramp Both RF and CDU false acq with static offset. −137.0 2nd RNG component −150.0 3rd RNG component RF and CDU lock			146	U/L levels set for Orbiter. With ramp, no false acq. At static offset, both RF acq and CDU lock. However, unable to repeat CDU lock.
N/A	3B 1F TLM-G	304 	Lander Orbiter Test XMTR	Orbiter False U/L RF lock (−150 dBm) RCVR VCO 23.3661000 Orbiter 2111.604907 −150.0 dBm 3rd RNG comp RF and CDU lock 29th harmonic			75	U/L levels set for Orbiter. False acq of both carrier and CDU occurred as expected.
N/A	5AR 1F TLM-G	304 	Lander Orbiter Test XMTR	No apparent CMD degrad No significant TLM degrad SNRs during ramp: Ref. SNRs 7.83 dB HR: 7.77 dB HR 12.68 dB LR: 13.02 dB LR			129	Orbiter TLM. 4000 bps coded HR. 8.33 bps coded LR. U/L levels set for Orbiter.
N/A	5AR 1FR TLM-G	305 	Lander Orbiter Test XMTR	TBD		TBD	189	Orbiter ranging: Code comp = 10 Clock acq = 120 s Component acq = 2 s DRVID acq = 120 s, 5 points
N/A	5B 1F TLM-F	304 	Lander Orbiter Test XMTR	16.4 dB LR 2.5 dB HR 13.19 dB LR 7.62 dB HR 15.75 dB LR 6.5 dB HR	Lander Orbiter Test XMTR	Reference data.		Lander HR data low (6 dB). Suspect SDA.
N/A	5B 1F TLM-F	304 	Lander Orbiter Test XMTR	16.21 dB LR 2.52 dB HR 13.0 dB LR 7.5 dB HR 15.2 dB LR 6.44 dB HR	Lander Orbiter Test XMTR	No degradation from reference data.	124	
N/A	5B 1F TLM-F	304 	Lander Orbiter Test XMTR	16.31 dB LR 2.47 dB HR 13.1 dB LR 7.14 dB HR 15.07 dB LR 6.48 dB HR	Lander Orbiter Test XMTR			
N/A	5B 1FR 1G	305 	Lander Orbiter Test XMTR	9.52 dB HR 16.98 dB LR 4.24 dB HR 9.71 dB LR 3.44 dB HR 15.33 dB LR	Lander A2 B1 Orbiter A3 A1 Test XMTR B3 B2	7.9 ± 1.5 dB 14.7 ± 1.5 dB 3.4 ± 1.6 dB 8.0 ± 3.3 dB 3.3 ± 1.6 dB 11.7 ± 3.3 dB	385	
1:0.350 Hz 2:2.125 Hz 3:2.2 Hz 4:0.225 Hz 5:0.225 Hz 6:2.2 Hz				9.3 dB HR 17.54 dB LR 4.3 dB HR 10.1 dB LR 3.7 dB HR 16.98 dB LR	Lander Orbiter Test XMTR 	7.9 ± 1.5 dB 14.7 ± 1.5 dB 3.1 ± 1.7 dB 7.3 ± 3.6 dB 3.0 ± 1.7 dB 11.2 ± 3.3 dB		

Test date (1974)	Test title	Test No.	Deep Space Network						
			RCV	EXC	RNG	CMD	Uplink doppler, Hz/s	Uplink offset	CMA SUBC offset
7/29	Multiple S/C telemetry performance (contd)	6	−137.0(2) −134.5(1) −118.5(3)	−121.5(1) −111.5(2) N/A	OFF(1) ON(2) N/A	OFF	N/A	+20 kHz	N/A
7/27	Multiple S/C telemetry performance	7	−137.0(2) −134.3(1) −111.0(3)	−120.0(1) −110.0(2) N/A	ON(1) OFF(2) N/A	OFF	N/A	N/A	N/A
			−137.0(2) −134.3(1) −111.0(3)	−120.0(1) −110.0(2) N/A	ON(1) OFF(2) N/A	OFF	250(1) 13(2)	+20 kHz (1) +20 kHz (2)	N/A
			−137.0(2) −134.3(1) −111.0(3)	−120.0(1) −110.0(2) N/A	ON(1) OFF(2) N/A	OFF	N/A	+20 kHz (1) +20 kHz (2)	N/A
7/26	Multiple S/C command with doppler	8	−137.5(2) −129.5(1) −130.5(3)	−120.0(1) −114.0(2) N/A	OFF(1) ON(2) N/A	ON(1) ON(2) N/A	N/A	N/A	N/A
			−137.5(2) −129.5(1) −130.5(3)	−119.5(1) −115.5(2) N/A	OFF(1) ON(2) N/A	ON(1) ON(2) N/A	N/A	+20 kHz (1) +20 kHz (2)	−0.1 Hz −0.1 Hz
7/25	Multiple carrier D/L carrier analysis	9	− 93.5(2) − 95.5(1) − 91.5(3) − 93.5(2) − 96.0(1) − 89.0(3)	−120.0(1) −115.0(2) N/A N/A (one-way)	OFF(1) ON(2) OFF	OFF OFF	N/A N/A	N/A N/A	N/A N/A
7/25	Multiple carrier U/L spectrum analysis	10	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	−115 (2) −121.5(1) −115 (2) −121.5(1) −126.5(2) −133.0(1) −126.5(2) −130.5(1) −124.0(2) −133.0(1)	OFF OFF OFF OFF ON ON ON ON ON ON	OFF OFF OFF OFF ON ON ON OFF OFF ON	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
7/25	Multiple carrier D/L threshold and acquisition	11	−139.6(2) −138.0(1) −135.0(3) −139.6(2) −138.0(1) −135.0(3)	−119.7(1) −130.5(2) N/A N/A N/A N/A	OFF(1) ON(2) N/A OFF(1) OFF(2) N/A	OFF OFF OFF	N/A N/A	N/A N/A	N/A N/A

Notes: 1. RF channel assignments for all tests
Lander: Channel 13
Orbiter: Channel 9
Test XMTR: Channel 20

2. Orbiter X-band D/L turned on for Tests 1, 2, 3, 4, 5.

Spacecraft				Test data			Test time, min	Test comments
SDA SUBC offset	Mode	RM	S/C	Performance		Criteria		
1:0.350 Hz				9.06 dB HR	Lander	7.9 ± 1.5 dB		
2:2.125 Hz				16.54 dB LR		14.7 ± 1.5 dB		
3:2.2 Hz				4.32 dB HR	Orbiter	3.2 ± 1.7 dB		
4:0.225 Hz				10.2 dB LR		7.7 ± 3.3 dB		
5:0.225 Hz				3.64 dB HR	Test XMTR	3.1 ± 1.7 dB		
6:2.2 Hz				15.52 dB LR		11.5 ± 3.3 dB		
N/A	5AR		Lander	17.51 dB LR	Test XMTR A2	N/A	171	Blk IV RCV threshold degraded; TLM criteria for Test XMTR not applicable.
	1F		Orbiter	23.1 dB LR	Lander B1	20.8 ± 1 dB LR		
	1G		Test XMTR	5.36 dB HR	Orbiter A3	3.4 ± 1.6 dB HR		
				11.28 dB LR	Orbiter A1	8.0 ± 3.3 dB LR		
				9.0 dB HR	Test XMTR B3	N/A		
LE 1:0.350 Hz	5AR		Lander	17.6 dB LR	Test XMTR	N/A	171	Blk IV RCV threshold degraded; TLM criteria for test transmitter not applicable.
LS 2:N/A	1F		Orbiter	22.55 dB LR	Lander	20.8 ± 1.5 dB		
OS 3:2.2 Hz	1G		Test XMTR	5.42 dB HR	Orbiter	3.1 ± 1.7 dB		
OE 4:0.225 Hz				11.38 dB LR		7.3 ± 3.6 dB		
TTE 5:0.225 Hz				9.0 dB HR	Test XMTR	N/A		
TTS 6:2.2 Hz								
1:0.350 Hz	5AR		Lander	17.96 dB LR	Test XMTR	N/A		
2:N/A	1F		Orbiter	22.7 dB LR	Lander	20.8 ± 1.5 dB		
3:2.2 Hz	1G		Test XMTR	5.39 dB HR	Orbiter	3.2 ± 1.7 dB		
4:0.225 Hz				11.14 dB LR		7.7 ± 3.3 dB		
5:0.225 Hz				9.0 dB HR	Test XMTR	N/A		
6:2.2 Hz								
N/A	5B		Lander	Ranging acquisition			187	Ranging: 10 components
	1FR		Orbiter	CMDs to Orbiter (5)				Clock acq time = 120
				CMDs to Lander (three 32-word)				Code comp acq = 2
	1G		Test XMTR	No degrad to either S/C				DRVID averaging = 120
N/A	5B		Lander	CMDs to Orbiter (5)				
	1FR		Orbiter	CMDs to Lander (three 32-word)				
	1G		Test XMTR	No degrad to either S/C				
N/A	5B	305	Lander	TBD		TBD	173	Photos taken of Lander, Orbiter, and test XMTR.
	1FR		Orbiter					
	1G		Test XMTR					
N/A	5B	305	Lander	TBD		TBD		Fourier analysis of D/L spectra will be provided at a later date.
	1FR		Orbiter					
	1G		Test XMTR					
N/A	N/A	N/A	Orbiter	TBD		TBD	90	Photos taken of all configurations. U/L frequencies at Orbiter and Lander best locks.
N/A	N/A	N/A	Lander					
N/A	N/A	N/A	Orbiter					
N/A	N/A	N/A	Lander					
N/A	N/A	N/A	Orbiter					
N/A	N/A	N/A	Lander					
N/A	N/A	N/A	Orbiter					
N/A	N/A	N/A	Lander					
N/A	N/A	N/A	Orbiter					
N/A	N/A	N/A	Lander					
N/A	5B	305	Lander	−162.4 dBm		−160.0 ± 2 dBm	212	Two-way.
	1FR		Orbiter	−158.7 dBm		−158.0 ± 2 dBm		Two-way.
	1G		Test XMTR	−156.7 dBm		−158.0 ± 2 dBm		One-way.
N/A	5B	305	Lander	−161.9 dBm		−158.0 ± 2 dBm		One-way.
	1FR		Orbiter	−159.4 dBm		−158.0 ± 2 dBm		One-way.
	1G		Test XMTR	−156.5 dBm		−158.0 ± 2 dBm		One-way.

3. All dBm settings for uplink and downlink are carrier power (P_c). Uplink levels established before RNG/CMD modulation applied, except in Tests 1, 2, 3.

4. SDA assignments for tests

Lander ENG:	1	Orbiter ENG:	4
Lander SCI:	2	Test XMTR ENG:	5
Orbiter SCI:	3	Test XMTR SCI:	6

Table 4. Definition of terms for Tables 1, 2, and 3

Term	Definition
Bit rate	Clock frequency of the telemetry bit information
Car. sup.	Downlink carrier suppression due to telemetry modulation
CMA SUBC offset	Command modulation assembly subcarrier frequency offset relative to nominal
D/L	S-band RF downlink
DSN CMD	Telemetry and command data handling command modulation
DRVID	Differenced range versus integrated doppler
DSN EXC	The standard DSN Block III S-band exciter equipment
DSN RCVR	The standard DSN Block III S-band receiving equipment
HR	High rate
LR	Low rate
P_c	Power in carrier
DSN RNG	Planetary ranging assembly modulation
S/C ant	Spacecraft antenna
S/C CDU	Spacecraft command detector unit
S/C EXC	Spacecraft S-band exciter equipment
S/C mode	Spacecraft telemetry mode
S/C PWR	Spacecraft transmitter power mode
S/C RCVR	Spacecraft S-band receiving equipment
S/C RNG	Spacecraft ranging channel—ON/OFF
S/C RM	Spacecraft radio mode
S/C TMU	Spacecraft telemetry modulation unit
S/C TWT	Spacecraft traveling wave tube amplifier
SDA SUBC offset	Subcarrier demodulator assembly subcarrier frequency offset relative to nominal
TBD	To be determined
TLM	Telemetry
U/L	S-band RF uplink
Uplink doppler	Ramp rate of the uplink carrier frequency
Uplink offset	Uplink carrier frequency offset relative to the spacecraft receiver rest frequency

Table 5. RF channels and center frequencies for special RF interference tests

	Orbiter Channel 9, MHz	Lander Channel 13, MHz	Test transmitter Channel 20, MHz
DSN receive	2293.148148	2294.629630	2297.222222
DSN transmit	2111.607253	2112.971451	Not Applicable